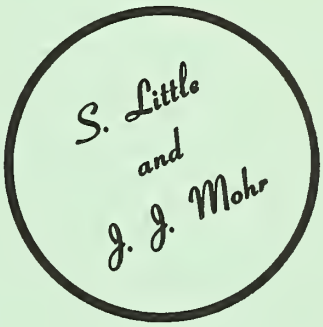
Reproducing Pine Stands On The Eastern Shore Of Maryland

using a seed-tree cutting and preparing seedbeds with machinery and summer fires



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FOREWORD

This progress report presents the first-year results of a study undertaken cooperatively by the Maryland Department of Forests and Parks and the Northeastern Forest Experiment Station.

Although these early results cannot be considered final, they suggest one way to solve the problem of reproducing pine stands, a problem of great importance to the economy of the Eastern Shore of Maryland. Other possible solutions to this problem are also being studied cooperatively.

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THE PROBLEM

PURE PINE STANDS are the most profitable forest crop on upland sites of the Eastern Shore of Maryland. These stands have been common in the past, because loblolly pine and pond pine usually made up most of the first forest growth on abandoned farmland. And apparently nearly all upland sites have been tilled at one time or another.

But land use has become relatively stable; little farmland is being abandoned to grow up to pine, and the present forest area must be relied on for timber crops. This creates a problem; for here, as elsewhere, the natural trend is for hardwoods to invade these pine stands, and eventually

to crowd out the pines. Since the value of pine timber has risen greatly in recent years, the problem of controlling the hardwoods is important.

On these sites, pines cannot be kept as part of the stand in permanently forested areas unless drastic measures are taken to favor the pines. Light cuts--which disturb the forest floor only slightly--favor the undesirable hardwoods, because these are more tolerant of shade than the pines.

(Of course there are cutover areas where the new stand is predominantly pine, because poor seed sources or some disturbances have retarded the development of hardwood understories. For example, where a pine stand is surrounded by fields there may be no nearby source of hardwood seed. Running livestock in the woods, light fires that did not kill the pine overstory, and removal of "shats" (needle litter) are disturbances that have hindered development of hardwood understories--probably more in the past than recently. Because of the effects of these disturbances and the disturbances caused by logging, two or three crops of timber containing large proportions of pine may be produced before hardwoods completely capture an old-field site.)

The two common types of commercial cuttings do little to check the successional trend to hardwoods. A relatively light cut for such special products as piling usually just stimulates the growth of understory hardwoods and shrubs, although a source of seed for reproducing the pines is left. The more common heavy cut usually leaves hardwoods and spindly pines--inadequate seed sources--in possession of the area; and only in greatly disturbed spots, such as along skid roads, can pine seedlings form a new stand.

The desired pine stands could be reproduced if an adequate source of seed were provided along with a suitable seedbed, and if competing hardwoods and shrubs were controlled. There are several methods for providing these conditions:

Cuttings might follow the seed-tree system (9)[1], group clear-cutting (2), strip clear-cutting, or shelterwood system (4). Seedbeds might be improved by the use of machinery such as bulldozers (5), or tractors pulling one or two large stumps, or a heavy disk or disk plow (8); or they might be improved by the use of light winter fires (6) or by

[1]Underlined numbers in parentheses refer to Literature Cited, page 11.

a hot fire in late summer (2, 8)--or even by pigs. And hardwoods might be checked or partly controlled by silvicides (1), by the machinery and fires mentioned above (1, 3), or even by running goats in the area.

A study was made on the Eastern Shore of Maryland in an effort to reproduce a pine stand on such sites. The cutting used was a seed-tree cutting, a modification of the usual heavy commercial cutting. To prepare seedbeds for pine, machinery and a summer fire were used. These treatments were made before pine seeds of the 1951 crop fell. The plots were re-examined in the summer of 1952. These first year results are described in this report.

STAND CONDITIONS

Before Cutting

On the basis of a 100-percent cruise by State personnel, the 30-acre study area had 120 pines and 13 hardwoods per acre that were 8 inches d.b.h. and larger. Nearly all these trees were less than 22 inches in diameter. Estimated volumes were 12,855 board feet of pine and 610 board feet of hardwood per acre--relatively low because of an earlier cutting for piling.

Data on trees less than 8 inches d.b.h. were obtained from 200 milacre-quadrats (each 6.6 feet square). Pine reproduction was present on 22 percent of the quadrats, at an average rate of 920 per acre. The tallest pines on stocked quadrats had an average height of 2.1 feet.

Of course hardwoods were much more common in the understory than pine. There were 5,290 seedlings or sprout-clumps of hardwoods per acre, stocking about 95 percent of the quadrats. The tallest stems were 8.2 feet tall on the average. These hardwoods were chiefly water oak, red maple, holly, sweetgum, and blackgum; they also included some black oaks, white and post oaks, willow oak, and sweetbay. Black cherry, dogwood, sweet pepperbush, and other tall shrubs were not included in the tallies.

After Cutting

The cutting removed all the pine overstory except 10 trees per acre selected and marked with paint before cutting, and a few smaller pines that the operator left.

The volume reserved in seed trees amounted to about 2,000 board feet per acre.

The commercial operator paid about $32 a thousand for the estimated volume of pine and hardwoods cut, in spite of penalties included in the contract. Penalties were provided for cutting or damaging seed trees, failure to cut or poison all hardwoods 8 inches or larger at 1 foot above the ground, failure to maintain woods roads, and failure to keep slash at least 10 feet from seed trees or to remove slash from roads and ditches.

The effect of cutting the overstory on smaller trees is discussed later--along with the effects of the additional treatments.

PLOT TREATMENTS

The 30-acre tract was divided into four plots, in three of which treatments supplementing the seed-tree cutting were made.

One of these treatments was the use of a small bulldozer pulling a stump or a Ranger Pal plow to expose a mineral-soil seedbed for pine. The tractor was small (total weight 3,000 pounds, with a $4\frac{1}{2}$-foot blade). The stump used for dragging was oak, about 17 inches in diameter at ground level, and the first 2 feet or so of the major roots were still attached to it.

In this treatment, the tractor operator pushed over small hardwoods and tall shrubs with the bulldozer blade, and the stump or plow dragging behind exposed mineral soil. When the stump was used, two or three trips were needed over the same path to expose mineral soil. The paths prepared this way were 6 to 10 feet apart.

This treatment was made before logging in two plots, one being treated with the stump drag, the other mostly with the plow. Operating time for the tractor, operator, and usually a guide averaged about $2\frac{1}{4}$ hours per acre where the stump was used, 1 hour per acre where the plow was used.

The second treatment was the use of a summer fire after the seed-tree cutting. Two of the plots were treated this way, one of which had been treated before cutting by the tractor pulling a stump. Both plots were burned on September 10, but the intensity of the fire varied and not all of both plots were burned. Green slash from recently

felled trees was the chief reason why small parts of the plots burned lightly or not at all. As might be expected, the fires in dry slash were quite intense, killing and consuming the green foliage of hardwoods 20 feet tall, killing needles on some of the seed trees, and even burning in the top of an occasional seed tree. Prior to burning, lines were plowed along the boundaries of the plots and through the plots. The burning took about 56-man hours, or about 4 man-hours per acre.

(Some seed trees were killed by the fire or were later overthrown by wind. Some of these were salvaged by State personnel in April 1952. On the two burned plots there were eight dead or dying standing seed trees and four windthrown trees, or slightly less than one per acre.)

RESULTS

Seed Production

The ten seed trees left per acre shed a large amount of seed in the fall and winter of 1951-52. 1951 was a good seed year and the seed trees had been selected from the best seed-producers in the stand.

Pine seeds of that crop fell in the study area at the rate of 179,000 per acre (on the basis of four traps, each 1/16 milacre in size, that were randomly installed in each plot). About 149,000 of these seeds were sound. In three plots there was little difference (200-204,000) in the number of seeds caught, but in the other plot only about half as many seeds were caught. This plot was the one treated with both machinery and fire.

Seedbed Conditions

Seedbed conditions at the time seed fell were measured on the 50 milacre-quadrats in each plot. These conditions are summarized in table 1.

Burning had much more effect on seedbed conditions than did the machine treatment used in this study (table 1), even though the data for the burned plots include a few quadrats that were not burned. Burning usually eliminated most of the slash, leaving only the large limbs and upper boles; and these were generally left flat on the ground, instead of propped up in the air. However, burning exposed little of the mineral soil, and in most of the area did not

Table 1.--Seedbed conditions in the fall of 1951

Treatment	Area with--			Average depth of duff
	Exposed soil	Exposed H-layer	Covering of slash	
	Percent	Percent	Percent	Inches
None (other than seed-tree cutting)	0.1	0.6	35.5	3.8
Plowing before cutting	3.3	3.4	32.3	3.1
Burning after cutting	2.7	10.0	2.8	1.8
Stump-dragging before cutting and burning after cutting	13.1	16.8	2.3	1.1

consume all the F-layer[2] (partially decomposed layer) of the forest floor. But the depth of the duff or forest floor was reduced by at least half.

In contrast, the machine treatment made before logging had far less effect than the burning, in part because logging slash, moving of the duff in skidding, and the fresh fall of leaves obscured or obliterated the machine treatment. However, the depth of duff was slightly reduced, and the amounts of exposed soil and H-layer[2] were slightly increased (table 1).

Advance Pine Reproduction

None of the pine reproduction present before logging survived the logging and other treatments. Most of this reproduction had been found along old woods roads and in openings--the very places the logging crew would use for skidding and hauling.

The skidding was done with animals, but this was for very short distances; and the half-track truck used in haul-

[2]The forest floor or duff is the layer of dead organic debris covering the mineral soil. The uppermost part is composed of freshly fallen or slightly decomposed organic materials; this is called the 'litter'. Below this are the partly decomposed organic materials, called the 'F-layer'. Below this are highly decomposed organic materials, black in color and retaining none of their original shape; this is called the 'H-layer'.

ing ran through much of the area. It was probably this truck that did most of the damage to advance reproduction, although much reproduction was damaged on the areas treated with the tractor. Since no tallies were made between treatments, the damage cannot be evaluated exactly. But no advance pine reproduction was found in the summer of 1952 in the area only logged, or in those also treated with fire or machinery.

New Pine Reproduction

Thus the pine reproduction present in 1952 (table 2) were all seedlings that started in the spring of 1952. The stocking and amount of this pine reproduction were greatest on the area treated with both machinery and fire, followed by the area treated with fire, the area plowed, and last the area only logged. Still the amount and stocking of reproduction in the area only logged were high (4,080 per acre, stocking 78 percent of the quadrats).

The amount and stocking of pine reproduction were analyzed with statistical tests. These showed that the burned plots had real differences in amounts of pine reproduction compared to the untreated control plot, and significantly better stocking. Plowing produced more pine reproduction than the untreated control plot had, but significantly less than the use of both machinery and burning. Differences between burning alone and plowing or both treatments combined were not significant.

The differences among the treatments used in this study are similar to those reported for loblolly pine in the coastal plain of North Carolina (7), but may be less than would occur in a drier year. Heavy precipitation during the early spring may have favored the germination and survival of loblolly pine more in 1952 than usual. And, if so, the establishment of seedlings on areas with undisturbed duff or slash was probably favored relatively more than that on areas disturbed by fire or machinery.

The treatments also affected the average height of the tallest seedlings on the stocked quadrats, even though these were 1952 seedlings measured in mid-July only to the nearest 1/10 foot. Still the average height of these in the burned areas was about 1/10 foot greater than in the untreated area, and statistical tests showed that this difference was real.

The differences in heights of pine seedlings--greatest on burned areas, less on disturbed areas, and least on

Table 2.--Reproduction before treatment and during the first growing season after treatment

Treatment	Before treatment (1951)	After treatment (1952)	Change
	Number	Number	Number
PINES PER ACRE			
Stump-dragged, summer-burned	840	9,400	+8,560
Summer-burned	660	7,640	+6,980
Plowed	360	6,160	+5,800
None	1,820	4,080	+2,260
HARDWOOD SEEDLINGS & SPROUT CLUMPS PER ACRE			
Stump-dragged, summer-burned	3,940	2,300	-1,640
Summer-burned	5,320	3,920	-1,400
Plowed	5,780	5,060	-720
None	6,120	6,320	+200
	Feet	Feet	Feet
AVERAGE HEIGHT OF TALLEST PINES[1]			
Stump-dragged, summer-burned	1.9	0.38	--
Summer-burned	3.9	.37	--
Plowed	1.3	.31	--
None	1.0	.28	--
AVERAGE HEIGHT OF TALLEST HARDWOODS[1]			
Stump-dragged, summer-burned	6.2	1.9	-4.3
Summer-burned	8.5	2.1	-6.4
Plowed	9.2	4.6	-4.6
None	8.7	5.3	-3.4
	Percent	Percent	Percent
QUADRATS STOCKED WITH PINE			
Stump-dragged, summer-burned	28	100	+72
Summer-burned	24	96	+72
Plowed	12	94	+82
None	26	78	+52
QUADRATS STOCKED WITH HARDWOODS			
Stump-dragged, summer-burned	84	70	-14
Summer-burned	98	90	-8
Plowed	96	92	-4
None	100	100	0
QUADRATS ON WHICH PINE IS FREE TO GROW[2]			
Stump-dragged, summer-burned	18	37	+19
Summer-burned	10	20	+10
Plowed	4	6	+2
None	4	0	-4

[1] On stocked quadrats..
[2] Or taller than any hardwoods in that quadrat.

relatively undisturbed areas--were also similar to results from the Southeast (7).

Hardwood Reproduction

Even though many hardwood seedlings, especially red maple and holly, started after the logging, all treatments caused a net decrease in the total number of hardwoods per acre (table 2). The biggest decrease was from the use of both machinery and fire, but fire alone caused almost as big a decrease. In contrast, on the untreated plot the total number of hardwoods increased by 200 per acre.

The four plots differed somewhat in the amount and stocking of hardwood reproduction present before the 1951 logging and other treatments. Possibly the smaller number of hardwoods in the area treated with machinery and fire may have been due, in part at least, to the removal of "shats" (needle litter) by a neighboring farmer. At least part of this plot had the appearance of having been so treated in the past.

Even though the treatments affected the amount and stocking of hardwood reproduction, their biggest effect was on the height of this reproduction. In the burned areas the average height of the tallest hardwoods on stocked quadrats was reduced to about 2 feet, in the unburned areas from about 9 feet to 5 feet (table 2). The use of machinery and logging caused a bigger reduction than logging alone, but the 1952 heights did not differ significantly. However, the 1952 height of the hardwoods in the burned plots was so much less than in the unburned plots that statistically this difference was very significant.

Future Dominance Of Pine Reproduction

Because all the pines found on the quadrats in 1952 were first-year seedlings, their future dominance and proportion in the stand cannot be estimated accurately.

However, it is evident that the burning treatments were effective in making conditions much more suitable for pine to form a large proportion of the next stand than plowing or just logging. For example, burning alone provided conditions such that on 20 percent of the quadrats pines were dominant in 1952, compared to 6 percent in the area plowed and none in the control. And all three plots had similar amounts and stocking of hardwoods in the spring of

1951 (table 2). Furthermore, on quadrats stocked with both hardwoods and pines, the pines were dominant in 1952 on 10 to 12 percent in the burned areas, on none in the unburned plots. And this difference was highly significant.

CONCLUSIONS

The results of this study indicate that pines may form the bulk (possibly 80 percent) of the next stand in the burned areas. But in the unburned areas they will be able to do this only in the hauling roads and similar spots that were greatly disturbed in logging, so that over the whole area less than half of the next stand may be pine.

Hence, in this study the use of summer fires proved superior to the use of machinery. Admittedly, heavier machinery or more complete working of the area by the available machinery might have reversed the results--but at greater cost.

Of course the use of summer fires has disadvantages. First, a fairly high investment is required in seed trees. However, if a large number are left, most of them could be removed after the seed had fallen on the fresh burn. Skidding and hauling these stems would be detrimental in burying pine seed, but probably not enough of the area would be affected to make much difference.

A second disadvantage is the need for limiting treatments to years when a sufficient seed crop is produced. Possibly in half of the years the crop is too small for summer fires to give the best results in many areas. Of course an alternative method that can be used in such years is planting after the summer burn.

The biggest disadvantage is the need for accomplishing a heavy and difficult work-load in a short time of suitable weather. This disadvantage can probably be overcome to a large extent by adequate planning and by providing a well-trained, well-supervised organization. Both the planning and supervision should apparently be done on all but the largest holdings by State personnel; but whether sufficient personnel can be found, particularly trained labor, is a serious problem. Of course this problem is common also in other phases of needed forest management.

Hence, while the use of summer fires offers promise, the extent to which they will be used is still questionable.

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